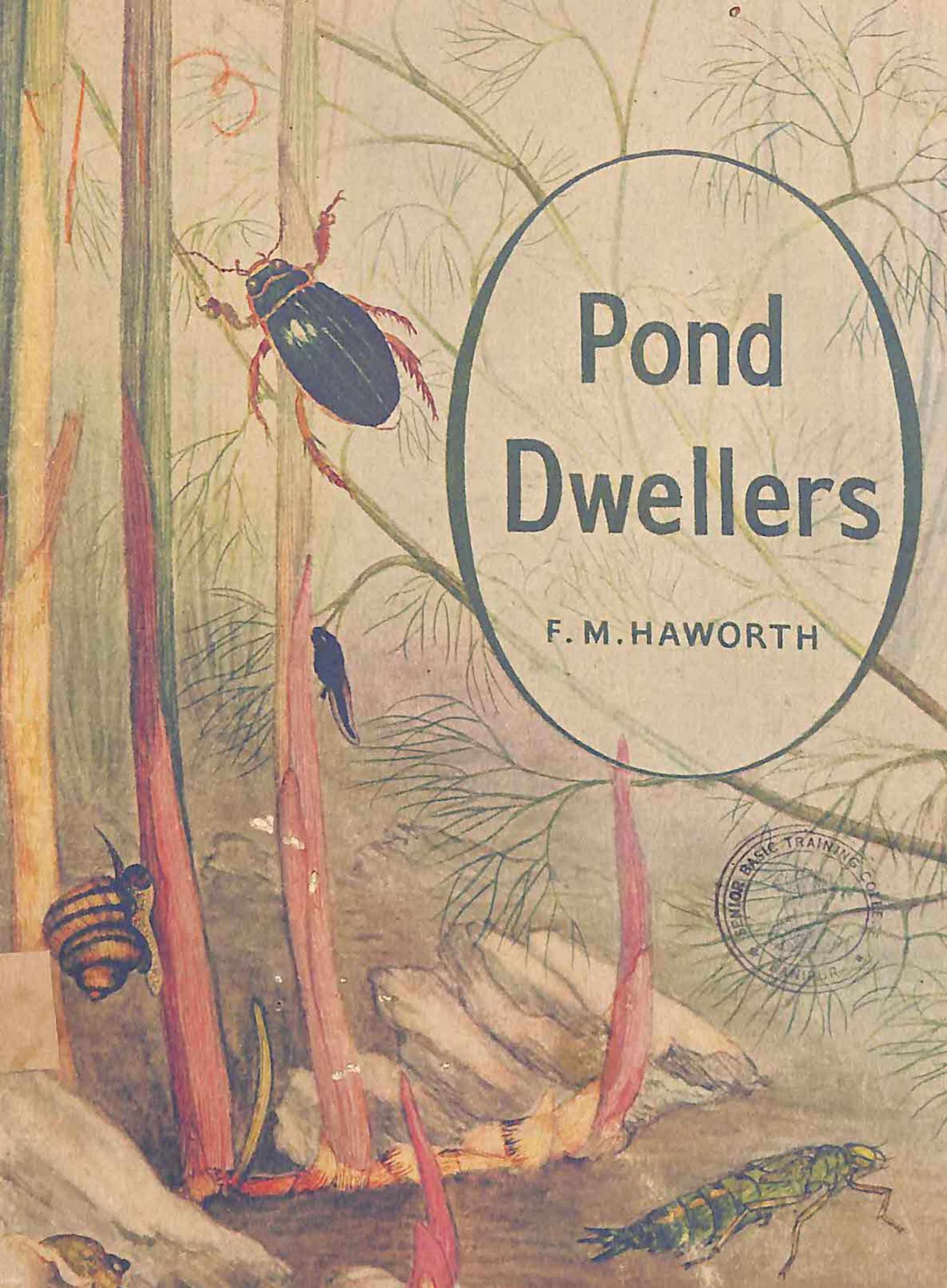


Pond Dwellers

F. M. HAWORTH

SENIOR BASIC TRAINING COLLEGE MANIPUR

713

NATURAL HISTORY SERIES

Number Two

ব
21

POND DWELLERS

F. M. HAWORTH, B.Sc., Ph.D.

Head of the Natural History Department
Froebel Educational Institute

Illustrated by

H. J. VANDERPLANK

SENIOR BASIC TRAINING COLLEGE ★ BANIPUR ★

Library
Calcutta
85/3, B. C. Road

UNIVERSITY OF LONDON PRESS LTD.
WARWICK SQUARE, LONDON, E.C.4

[illegible]
Date... 22,8,05
Accn. No. 11820

4218

POND DWELLERS

SENIOR BASIC TRAINING COLLEGE
BANIPUR

If you have set up and watched an aquarium of your own, you will know that a great many plants and animals live in water. Some animals—such as the fishes and water-beetles—spend their whole lives there, while others—like the dragonflies—are there only when young, and, when full-grown, climb out of the water and fly off into the sunshine to become true land dwellers.

The summer months are the best time to begin your study of a pond, for then something is always happening there. Choose a warm, sunny day in early June and take with you a pond net, a jam-jar in a string carrier, a shallow dish for examining your catch, and several small tins. With a hammer and nail make a number of holes in the lids of the tins from the inside.

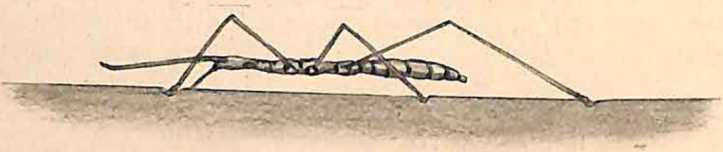
At first sit quietly at the edge of the pond and look down into the water; keep very still, for most animals will dart quickly away if a sudden shadow crosses its surface. As you look, try to imagine what it must be like in this underwater world. Thick forests of tall green stems and leaves move gently in the water. Sand or mud forms a soft carpet on which some creatures crawl, and here and there rocks and stones form caves and hiding-places for those creatures that need to escape from larger hungry ones. Some water dwellers are carnivores, and the lives of many animals that live in ponds must be full of narrow escapes.

How different this underwater world is from our own on dry land! Animals and plants here can drink whenever they are thirsty, while those that live on dry land often have to travel long distances

Water-spiders with their nest in water milfoil (opposite) to find water. You may have discovered in your aquarium that water changes temperature less quickly than air; in other words, it holds heat for a longer time. When evening comes and the air outside feels chilly, the water in a pond may still feel slightly warm.

You have probably noticed, too, that in winter, when the surface of the pond is covered with ice, fish and other animals can often be seen swimming under the ice in the warmer water below. It is interesting to make temperature records of the water throughout the year. They will help you to understand some of the problems of pond dwellers. Find out whether the surface water is the coldest part of the pond in the summer months as it often is in winter. What is the temperature at the bottom, and how does it compare with that at the surface? At what temperature does water freeze?

One strange thing about water is that the surface is covered with a thin transparent skin, or FILM as it is called. Some small insects, like water-skaters, can run and jump on this film and do not get their feet wet. They are able to do this because they are small and light in weight and their bodies and feet are covered with velvety hair which prevents the water making them wet. Their feet press down the film to make tiny pits, as you can see in the drawing below. Water-gnats also walk on the surface film, but they move slowly and have long, thin bodies.


×3

When first you look down into the pond, you may think that there are no animals there at all, but soon you will begin to notice movement everywhere. You will see something crawling over the sandy floor: it may be a water-louse or a caddis larva. Other creatures are crawling over the stems and leaves of the plants, and you will recognise pond snails, a leech, and a flat-worm. Numbers of creatures dart about quickly, and one comes to the surface to take a gulp of air, leaving circles of ripples on the surface film. It was probably a fish or a newt. Hovering over the water you see a large dragonfly and as it passes you hear the whirr of its wings.

The time has come when you feel that you must catch some of the animals you have seen so that you can look at them more closely. Hold the handle of the net firmly in both hands, and first skim the surface of the water. Move the net slowly backwards and forwards, then turn it inside out into a dish of shallow water. Use the pictures on pages 20 and 21 to help you name the animals which you have captured. Try again, but this time take your net half-way between the surface and the sand at the bottom; move it gently along the stems of the plants. Then, lastly, skim the surface of the sand at the bottom. Each time, empty your catch into the shallow dish to examine it. All these three places—the surface, the middle-water, and the sand—are the homes of different kinds of animals. When you have looked at the animals, put them back into the pond, and take home only those you want to keep in your aquarium.

Soft-bodied larvæ, such as those of dragonflies and mayflies, will travel best in damp weed in a tin, and snails can be put with them. Newts should also be in damp weed in a tin by themselves. Beetles, water-boatmen, water-scorpions, and water-spiders should be packed in dry grass in separate tins.

It is useful to make a book about a particular pond you know. Visit it as often as possible, so that you get to know the plants and animals in spring, summer, autumn, and winter. Make records and drawings and take photographs.

The rest of this book will help you to find out more about animals that live in ponds. Watching animals and plants becomes much more interesting when you know something about their lives.

POND SNAILS

Snails always carry a shell on their backs, for their bodies are soft, and they would be eaten quickly had they not got a house into which they could escape. Snail shells are very beautifully shaped. They are made in one piece and are therefore called UNIVALVES. In some the shell is twisted into a spiral with a sharp point, while others are twisted to make a flat coil.

Pointed shell

Flat coil shell

The shell of the GIANT POND SNAIL has six or seven twists, or WHORLS as they are called. The sharp point is the oldest part of the shell, and the last and biggest whorl contains most of the body of the snail. It is therefore called the body whorl. The outside of the shell is brown and rough to touch, but the inside is smooth and shiny like pearl. When a snail is moving about, it glides on a flat part of the body called the FOOT. At the front end of the foot is the HEAD, which has a mouth on the underside and on the upperside two feelers, or TENTACLES, with one dark eye at the bottom of each on the inside. When the snail moves, the head and foot are the main parts of the body outside the shell, but there is also a kind of curtain which hangs down over the body inside the shell; it is called the MANTLE.

Snails are vegetarians and have enormous appetites. They scrape off pieces of water plant with a curious ribbon which has hundreds of rows of teeth across it. These brown teeth can be seen at work scraping off the green growth on the glass of an aquarium.

Giant pond snails come to the surface of the water to breathe. They crawl along the under-surface of the film, and then suddenly a round hole appears and a little pop can be heard. You can then look down into the snail's lung. It is a very simple kind of lung, not a bit like our own, but nevertheless this snail breathes in the same way as we do. It takes air into the lung and then uses the gas oxygen that is present in air. It gets rid of a gas called carbon dioxide when it breathes out. The opening into the lung is of course closed before the snail goes under the water again.

During the summer, eggs are laid in jelly on the stems of water plants or on the glass of the aquarium. In time these eggs hatch. Find out how long they take. Do they always take the same time?

Let us look now at the FRESH-WATER WINKLES. They have a spiral shell of six or seven whorls striped with brown, but rather different in shape from that of the giant pond snail. It is easy to recognise the female, for both her tentacles are long and thin; in the male, one is thin and the other is short and fat. There is a picture on page 12 which shows the female.

The mouth is at the end of a tiny trunk, and on the upper side of the foot is a flat horny plate on which the shell can rest. This plate is also used as a door to the shell when the snail is inside. It fits the opening exactly and is called an OPERCULUM.

Fresh-water winkles do not come to the surface to breathe: they have gills as fish have, which enable them to use the oxygen that is dissolved in water. They do not lay eggs on water plants, but their eggs hatch inside the body of the mother, and tiny snails that appear suddenly in the aquarium are about two months old. They have shells just like those of their parents, only smaller.

See if you can write down at least six differences between fresh-water winkles and giant pond snails. It is important to notice these differences if you want to name pond snails. The drawings on the next two pages show the differences between some of the common ones.

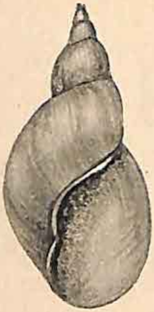
CLUES THAT WILL HELP YOU NAME SOME OF THE COMMON POND SNAILS

(*Drawings actual size*)

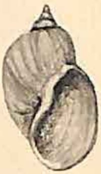
I. Snails that:

(1) Come to the surface to breathe and have a lung.
(2) Lay eggs on water plants and stones.
(3) Have no operculum on the foot.

Spiral shell twisted to the right

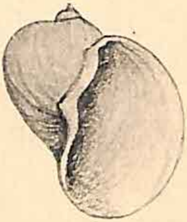


Giant pond snail
(*Limnea stagnalis*)



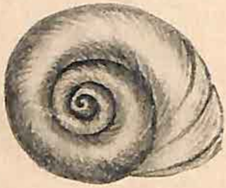
Wandering snail
(*Limnea pereger*)

Pointed spire

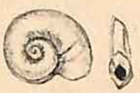


Ear snail
(*Limnea auricularia*)
Flattened spire

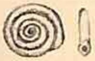
Flat coil shells



Ramshorn
(*Planorbis corneus*)

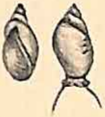


Keeled snail
(*Planorbis carinatus*)



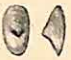
Whirlpool snail
(*Planorbis vortex*)

Spiral shell twisted to the left



Bladder snail
(*Physa fontinalis*)

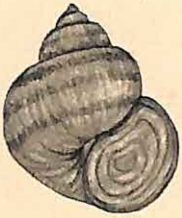
Hook shells



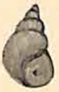
Fresh-water limpet
(*Ancylus lacustris*)

II. Snails that:

(1) Breathe by gills.
(2) Have an operculum on the foot.



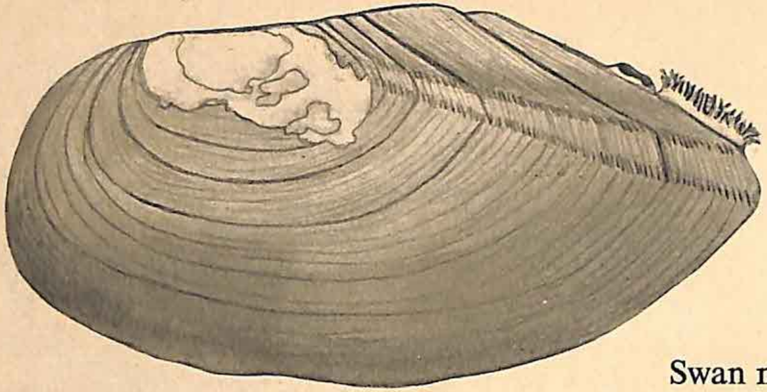
Fresh-water winkle
(*Paludina vivipara*)



Bythinia tentaculata

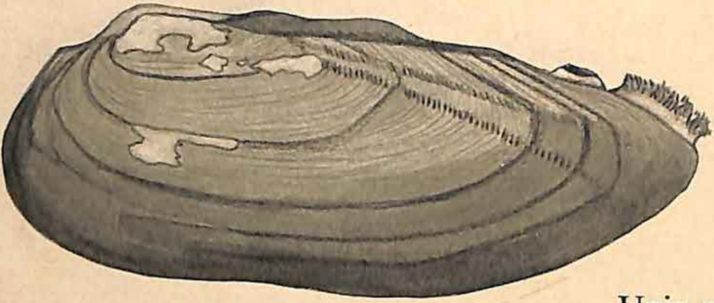
If you want to name the other snails you find, you should look in one of the following books, where you will find pictures:

Animal Life in Fresh Water, by H. Mellanby.
Living Creatures, by C. Von Wyss.
Introduction to Zoology, by R. Lulham.



Swan mussel

Orb-shell cockle



Unio mussel

Pea-shell cockle

POND MUSSELS AND COCKLES

So far we have looked only at shells that are made in one piece (univalves). In large ponds there may be swan mussels which have a shell in two pieces hinged together. These are called BIVALVES. They will live well in an aquarium. Though not very active creatures, they do move about by ploughing up the sand with a large pale-yellow foot which sticks out at the front end of the shell. These curious animals have no head, no tentacles, and no eyes. Mussels kept in an aquarium need to be fed on tiny water creatures. Water containing these is sucked in through an opening with a frilly edge at the hind end of the shell, the food passes into the mouth and the water is squirted out again through a second opening above the other one.

During early summer fine threads may appear among the plants in the aquarium. These threads have tiny dots on them. Under a microscope these threads look like a string of tiny beads. These beads are really hundreds of larvæ of the swan mussel. Each has a minute bivalve shell, and moves about by flapping the valves. If a fish swims among the weeds, the larvæ stick to its skin, and burrow into it, sucking the food they need from the fish. After about three months, when they are bigger and stronger, they push themselves free, sink to the bottom of the pond, and begin life on their own.

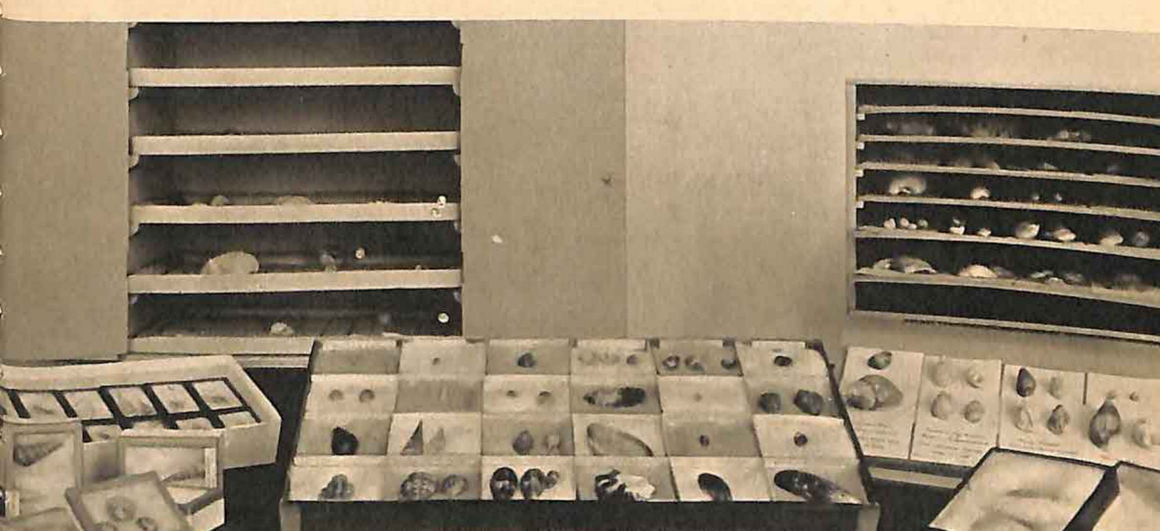
There is another mussel called UNIO; it is a little smaller and thinner than the swan mussel. A small fish called a Bitterling lays her eggs inside the shell, and there they hatch in safety. If you want to breed Bitterling, you will need to have unio mussels in the aquarium with them.

There are other small bivalves found crawling on pond weeds. They are the orb-shell cockles and pea-shell cockles.

If you look at the pictures opposite, you will see at once how you can recognise them.

When pond-dipping, one often finds empty shells, and some people make collections of them. A good collection should be housed in a box specially prepared for it. This can be made in different ways. A shallow wooden box can be adapted by dividing it into compartments with strips of wood or cardboard. Another good idea is to cut a piece from the top of a matchbox and then glue a piece of cellophane over the gap. Paint the box, then place the shell inside on a small piece of cotton-wool. Label neatly and always make a note of where the shell was found.

The photograph below shows various kinds of collections.



WATER-BEETLES

Some of the commonest water insects are the beetles. There are many kinds of them. The carnivorous beetle, or DYTISCUS as it is called, is often found in stagnant ponds where there is plenty of weed. It is easy to tell the male (♂) from the female (♀), for the ♂ has dark-brown smooth wings, while in the ♀ they are grooved. Underneath these brown wings are a second pair of thin, delicate ones used in flight. Beetles are excellent fliers as well as excellent swimmers, and often travel from pond to pond during the night. If you keep them in an aquarium, it is necessary to cover it, or they may escape.

They spend most of their lives in water. Watch them swimming. There are three pairs of legs. The third pair is broad, flat, and fringed with hairs; indeed, they are shaped like oars. As the beetle swims, these legs twist so that the flat side faces backwards as the legs press back, and then twist so that the flat side faces upwards as the leg is moved forwards again, just as an expert rower moves his oars.

In a pond they eat tadpoles, soft-bodied larvæ, and fish. They catch their food with their strong jaws and chew it up. These beetles come to the surface to breathe. They push the hind end of the body through the surface film and stay motionless for a short time, then they swim down into the water, carrying a silver bubble of air at the hind end of the body.

Insects breathe in an interesting way. They have not got lungs as we have, nor even a simple kind of lung like that of many pond snails. They have instead a network of tubes called TRACHEAL TUBES which carry air to all parts of the body and open to the outside through tiny holes or SPIRACLES. Through these spiracles air passes in and out. They often can be seen down the sides of an insect's body, and they open and shut.

In the water-beetle two of these spiracles are at the hind end of the body under the wings and others are farther forwards. When the beetle comes to the surface to breathe, the hind end of the body is pushed through the film into the air, the brown wings are lifted, and air passes through the spiracles into the tracheal tubes. At the same time a store of air is collected under the wings for use when the beetle is under water. Watch and find out how long this supply

Fresh-water molluscs (opposite)

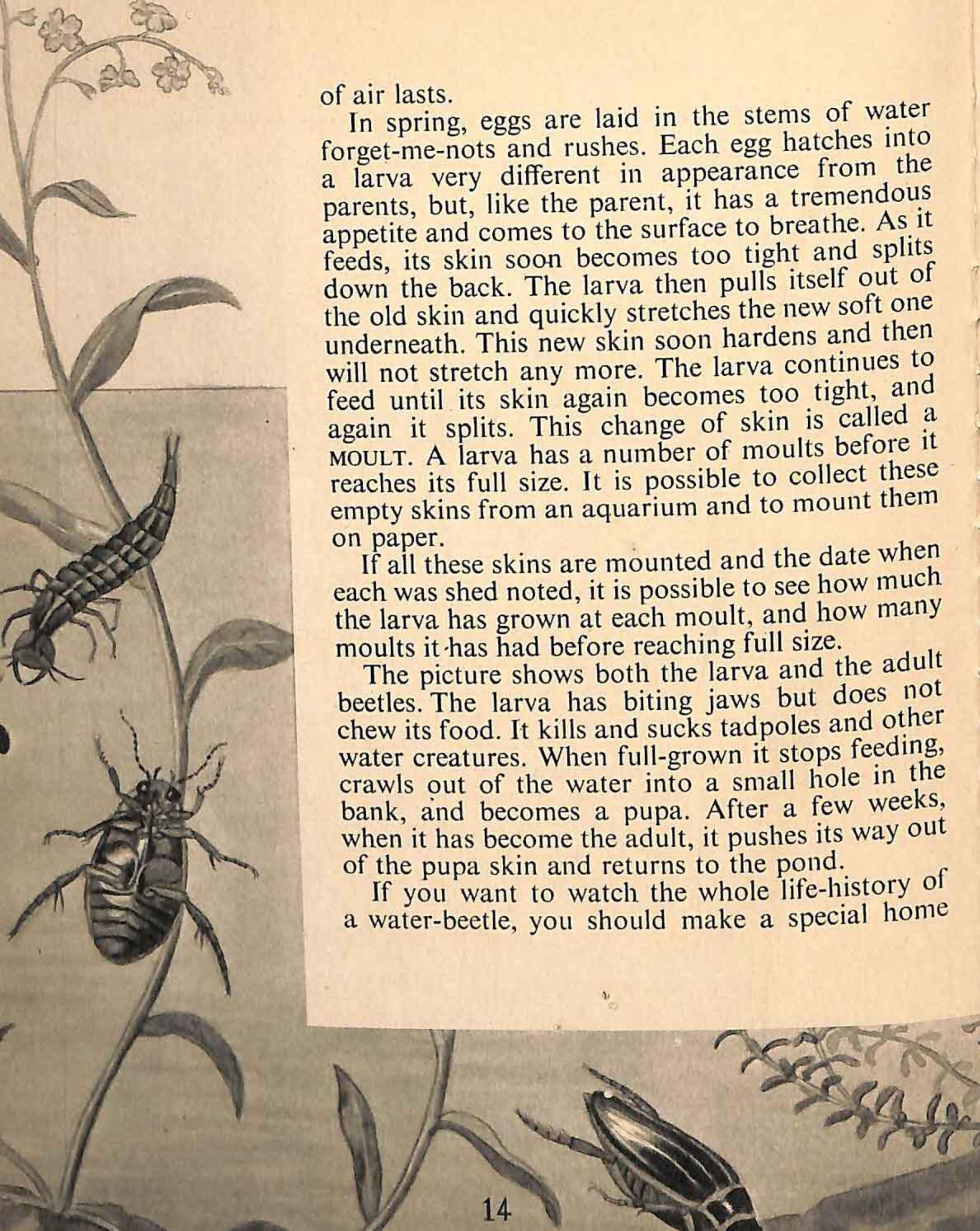
of air lasts.

In spring, eggs are laid in the stems of water forget-me-nots and rushes. Each egg hatches into a larva very different in appearance from the parents, but, like the parent, it has a tremendous appetite and comes to the surface to breathe. As it feeds, its skin soon becomes too tight and splits down the back. The larva then pulls itself out of the old skin and quickly stretches the new soft one underneath. This new skin soon hardens and then will not stretch any more. The larva continues to feed until its skin again becomes too tight, and again it splits. This change of skin is called a MOULT. A larva has a number of moults before it reaches its full size. It is possible to collect these empty skins from an aquarium and to mount them on paper.

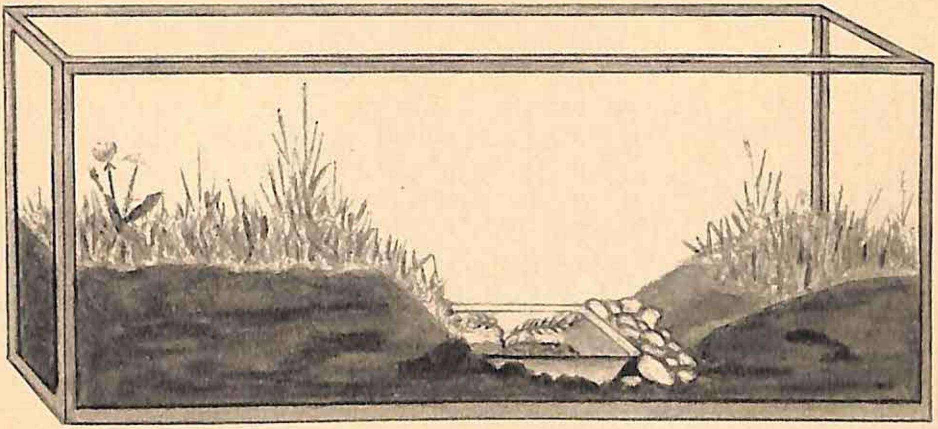
If all these skins are mounted and the date when each was shed noted, it is possible to see how much the larva has grown at each moult, and how many moults it has had before reaching full size.

The picture shows both the larva and the adult beetles. The larva has biting jaws but does not chew its food. It kills and sucks tadpoles and other water creatures. When full-grown it stops feeding, crawls out of the water into a small hole in the bank, and becomes a pupa. After a few weeks, when it has become the adult, it pushes its way out of the pupa skin and returns to the pond.

If you want to watch the whole life-history of a water-beetle, you should make a special home



11820



like the one above for the pupa. It was used by a larva caught in a pond-dipping on May 25th, 1951. Here is its history:

May 25th	Larva caught in a pond-dipping.
,, 26th	Moulted.
June 3rd	Moulted.
,, 13th	Now full size. Stopped feeding.
,, 14th	Took no food, so moved to a special tank like the one above.
,, 16th	Crawled out of the water and buried itself in the soil and changed into a pupa.
July 14th	Adult swimming in the water; it was a ♀.

How long did it take for the full-grown larva to change into the adult?

Beetles, therefore, have four stages in their life-history: first the egg, then the larva, then the pupa, and lastly the adult. Many other animals have this kind of life-history.

When pond-dipping, you are almost certain to see the WHIRLIGIG BEETLES that twist and turn at the surface. They are small and black with yellow legs. When disturbed, they dive quickly to the deeper water, carrying a silver air bubble with them at the end of the body.

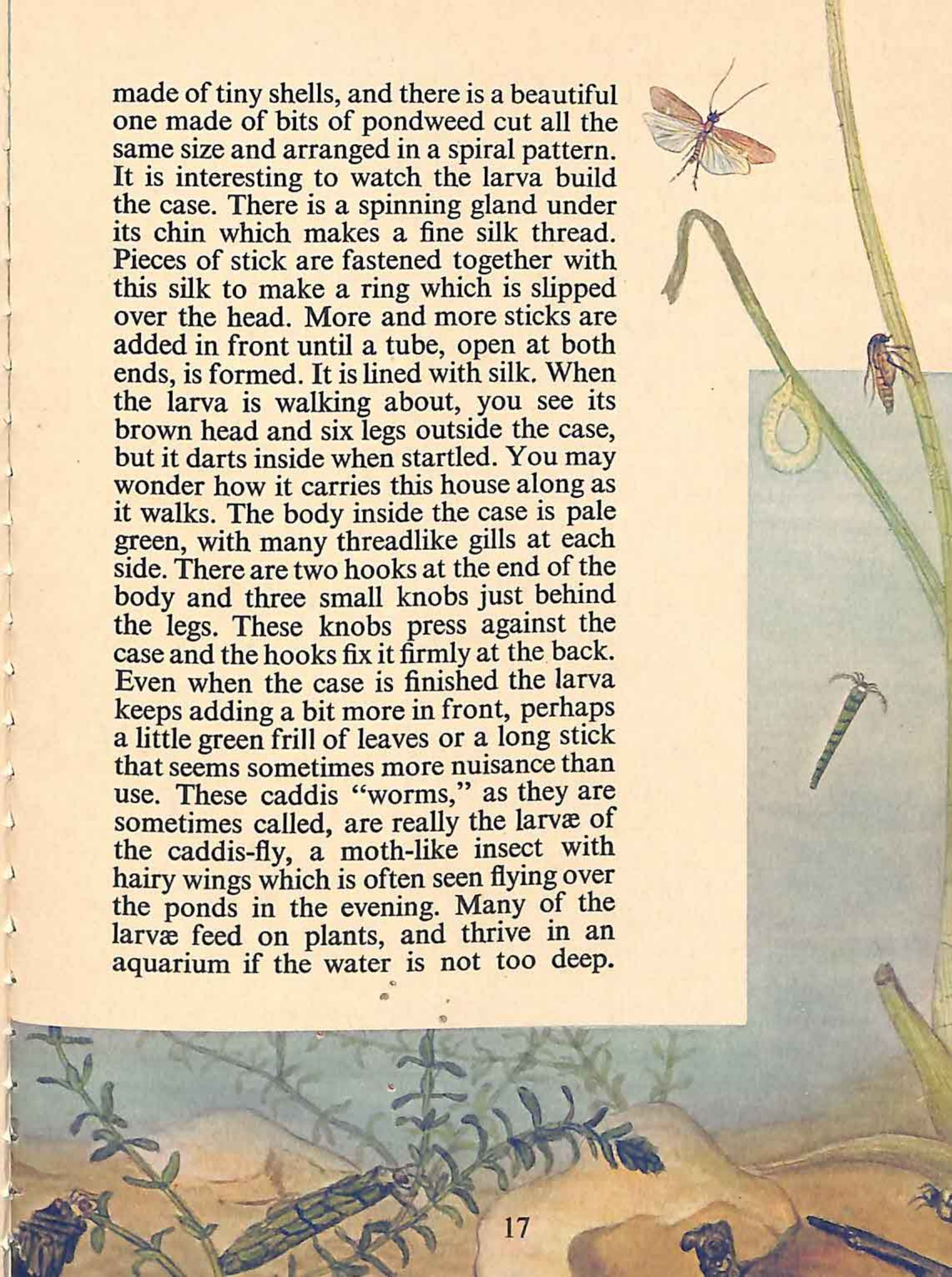
Other insects that spend their whole lives in water are the water-bugs. They suck their food through a kind of snout called a proboscis. There are the WATER-SKATERS that live on the surface film, the WATER-BOATMEN that swim in the middle-water region of the pond, and the curious WATER-SCORPIONS which are usually found at the edge of stagnant ponds crawling among the weeds.

The large water-boatman (*Notonecta*) or Backswimmer, as it is often called because of its habit of swimming upside down, is one of the dragons of the pond. It will attack and feed on other live creatures. It is about 1½ cm. long, with a boat-shaped body, and is grey or fawn coloured on the back and dark below. *Notonecta* comes to the surface to breathe just as the beetles do, and returns below water with a silver film of air over the body. It is a wonderful swimmer and diver, as is also the lesser water-boatman (*Corixa*) which swims the correct side up and is a vegetarian. *Corixa* spends much of its time at the bottom of the pond sucking up bits of plant food into its mouth. Both are excellent fliers and move from pond to pond.

Water-scorpions are quite flat and look like dead leaves. They are difficult to see but worth hunting for. Look at the picture in the centre of this book, and you will see the long breathing-tube sticking through the surface film.

CADDIS-FLIES

You may see the larvæ of caddis-flies crawling on the sandy bottom of the pond. These are strange little creatures, rather like caterpillars, that build themselves houses of sticks, stones, or sand, or sometimes even of the shells of baby pond snails and pond mussels. As soon as they hatch from the egg they begin to build. If the parents of the larva, when they were water dwellers, used sticks for their house, then the young larva will use sticks too. If the parents used sand, then the young larva will use sand. It is strange how they know just how to build and what material to use though they have never been taught. In the picture you can see some different kinds of houses. Some caddis fasten long sticks to little tubes of sand. Others cut pieces of stick all the same length and arrange them criss-cross, making a shaggy-looking case. One in the picture is made of tiny shells, and there is a beautiful one made of bits of pondweed cut all the same size and arranged in a spiral pattern. It is interesting to watch the larva build the case. There is a spinning gland under its chin which makes a fine silk thread. Pieces of stick are fastened together with this silk to make a ring which is slipped over the head. More and more sticks are added in front until a tube, open at both ends, is formed. It is lined with silk. When the larva is walking about, you see its brown head and six legs outside the case, but it darts inside when startled. You may wonder how it carries this house along as it walks. The body inside the case is pale green, with many threadlike gills at each side. There are two hooks at the end of the body and three small knobs just behind the legs. These knobs press against the case and the hooks fix it firmly at the back. Even when the case is finished the larva keeps adding a bit more in front, perhaps a little green frill of leaves or a long stick that seems sometimes more nuisance than use. These caddis "worms," as they are sometimes called, are really the larvæ of the caddis-fly, a moth-like insect with hairy wings which is often seen flying over the ponds in the evening. Many of the larvæ feed on plants, and thrive in an aquarium if the water is not too deep.



They grow by moulting many times, and when full grown fix their case to a stone and spin a silk curtain at each end. They then turn into a pupa and rest until the caddis-fly has formed inside the pupa skin. After a few weeks it bites its way out of the case, climbs up the stem of a water plant, splits its skin, and the caddis-fly pulls itself out, dries its wings, and flies away.

A few larvæ can swim actively in the middle-water region. Some have neat little green cases built in a spiral pattern, while others have a tiny curved case of sand grains. Make a collection of empty cases and see how many kinds you can discover. If you want to name them, look at the pictures in *Animal Life in Fresh Water*, by H. Mellanby, or *Introduction to Zoology*, by R. Lulham.

DRAGONFLIES

Some of the loveliest pond insects are the dragonflies. You will be certain to see their wonderful flight over the water if you visit a pond on a sunny day in June. Many of them travel great distances. Country people sometimes call dragonflies "horse-stingers," but this is an unfair name, for they cannot sting, and do not even bite anything bigger than an insect. Their four wings glisten in the sunlight as they dart past and disappear as quickly as they come. Their bodies are brilliant red, blue, green, yellow, or brown. Sit still and watch them as they fly over the water catching insects on which they feed. They hold their six hairy legs in front of their heads to make a tiny basket, which holds the flies they catch until they are ready to eat them. In *A Biology of Dragonflies*, a book by R. T. Tilyard, you can read how a dragonfly was seen at 7 p.m. darting round a bush where there were hundreds of mosquitoes. It was then caught carefully in a net, and was found to have its mouth so full of mosquitoes that it could not shut it!

Try to get near a large dragonfly that is resting on some reeds, and you will be able to see its wonderful shining eyes. They are so big that they almost meet in the middle of the forehead. You may see that it has three small eyes as well.

The large blue-and-brown dragonfly is called the *Aeschna*. It lives for a few weeks only, during the summer. Another large one often seen flying over ponds is called *Libellula*. It has a short fat body. Then there are many kinds about 1½ inches long called Damsel flies. They are wonderfully coloured in crimson and black, or black and powder blue. If you want to try to name them, read the book *Dragonflies of the British Isles*, by C. Longfield.

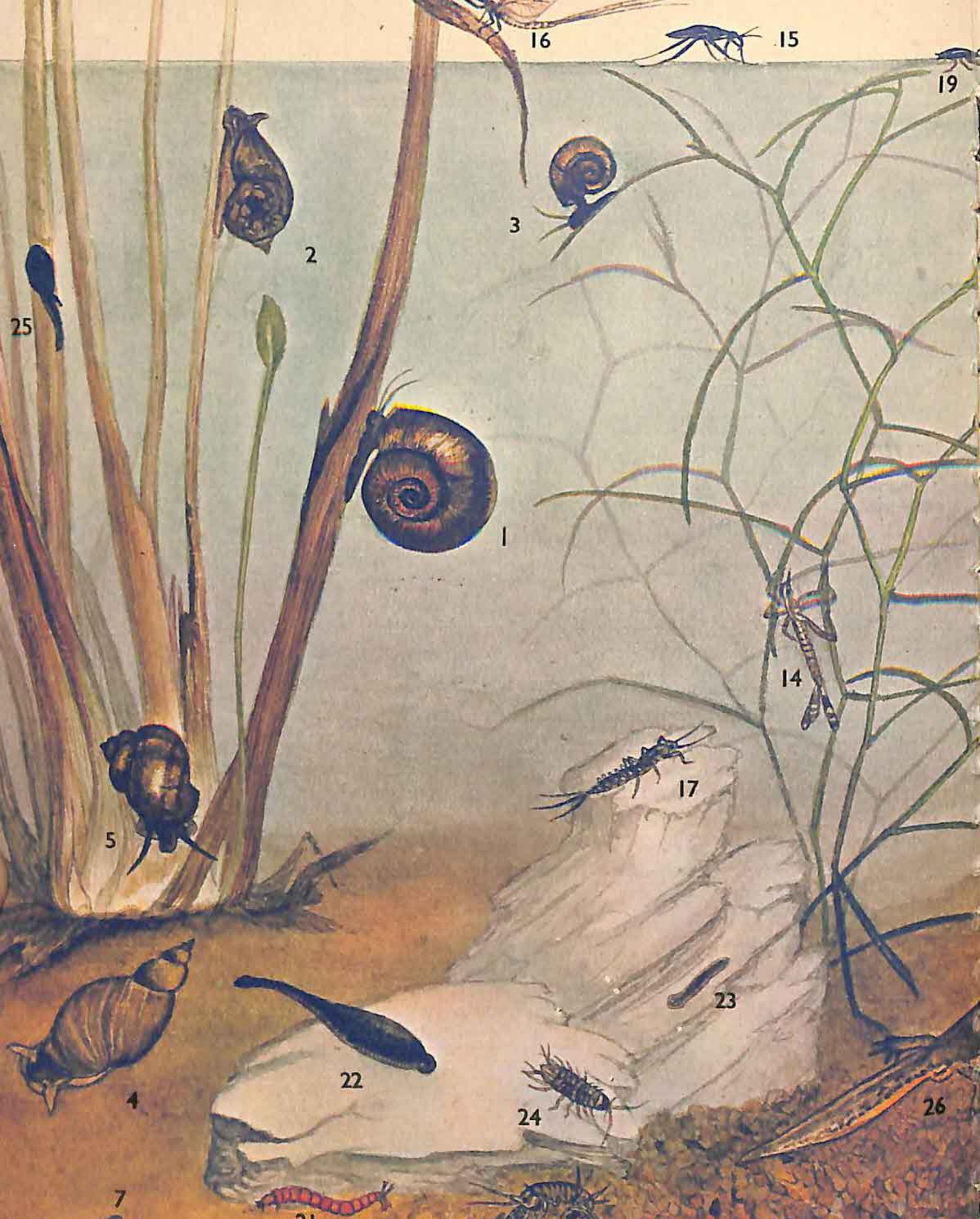
Look for dragonflies hovering over the surface of the pond, and you may see a female lay her eggs in the water. A curious little creature quite unlike the parents hatches from the egg. It is, of course, a larva. It spends all its time in the pond feeding, and you will often find one of them in pond-dippings. They are brown or greenish brown in colour, and though at first small, they grow quickly by a series of moults, and spend at least one year in water, but more often two or even three years. After five or six moults wings begin to form on the back of the larva and it is then called a NYMPH.

Look carefully at a full-grown nymph of the *Aeschna*, for this is a good one to keep in the aquarium. It is a fierce creature crawling about in search of food, and is a carnivore having a curious

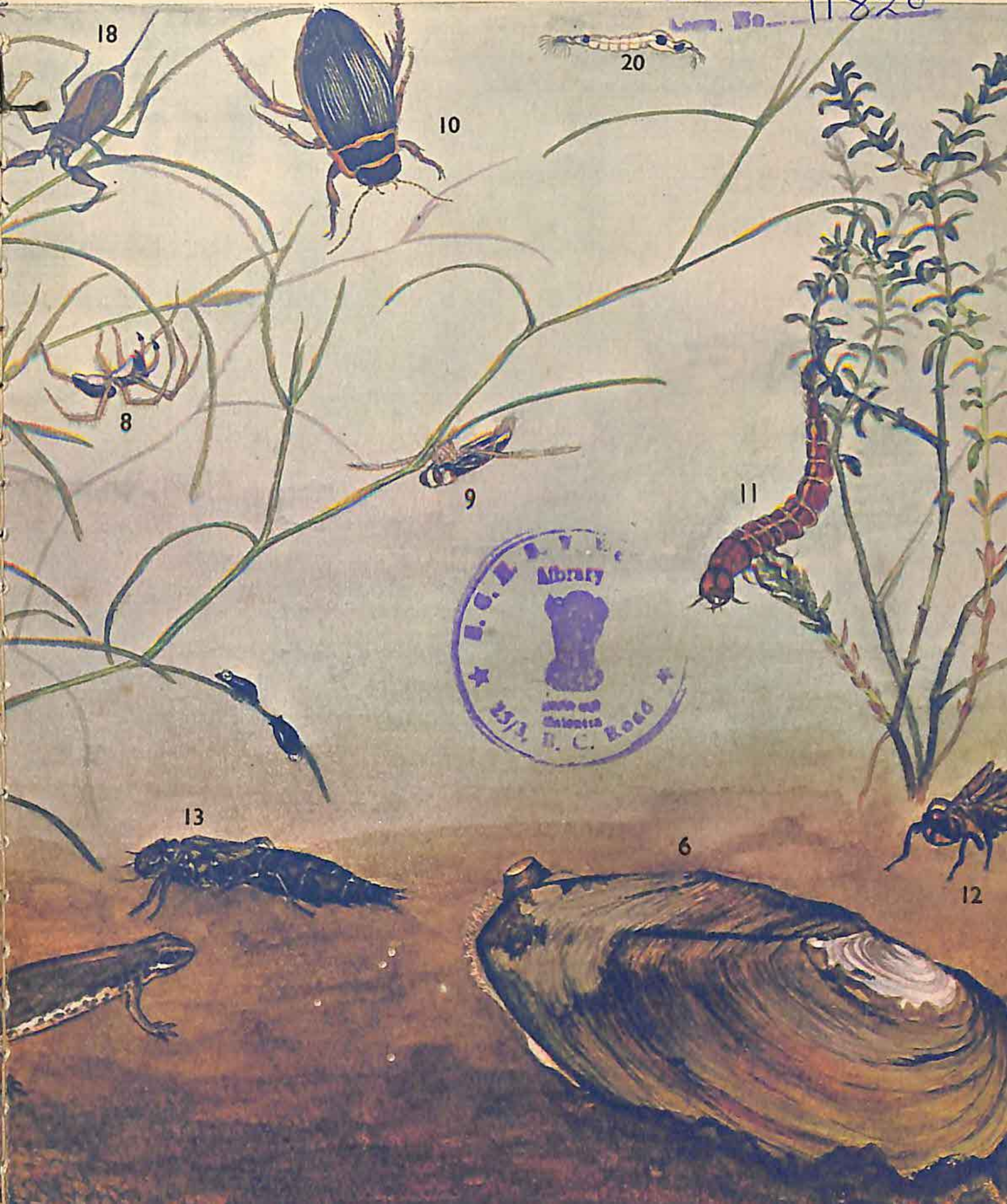
Turn to page 22

KEY TO THE PICTURE ON THE NEXT TWO PAGES

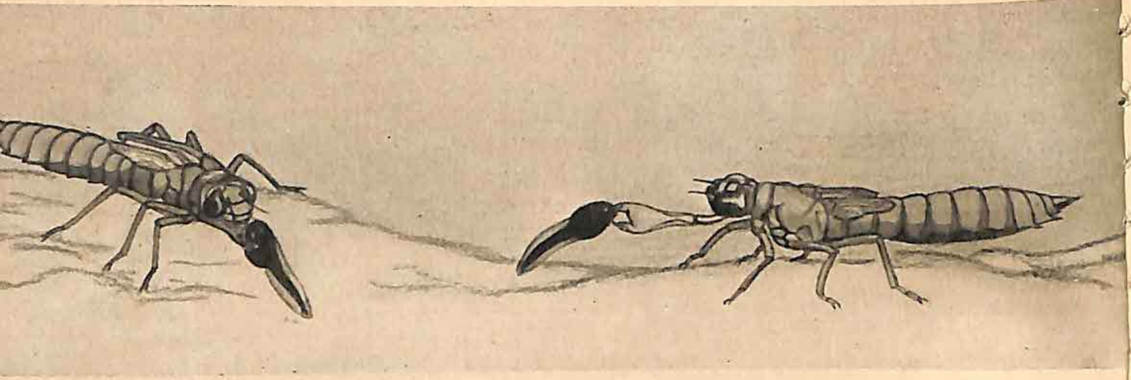
1. Ramshorn snail.
2. Wandering pond snail.
3. Keeled pond snail.
4. Giant pond snail.
5. Fresh-water winkle.
6. Swan mussel.
7. Orb-shell cockle.
8. Water-spider.
9. Great water-boatman.
10. Carnivorous water-beetle.
11. Larva of carnivorous water-beetle.
12. Short-bodied dragonfly larva.
13. Long-bodied dragonfly larva.
14. Agrion dragonfly larva.
15. Pond skater.
16. Mayfly.
17. Mayfly larva.
18. Water-scorpion.
19. Whirligig beetles.
20. Ghost larva.
21. Bloodworm (larva of midge).
22. Leech.
23. Flat-worm.
24. Water-louse.
25. Toad tadpole.
26. Common newt (female).
27. Fresh-water shrimp.


16
15
19
2
3
25
1
14
17
5
23
22
4
26
24
7
21

21
Date 22.8.05
Acc. No. 11820



S.C.E.R.T., W.B.
Library
Calcutta
25/3, B. C. Road

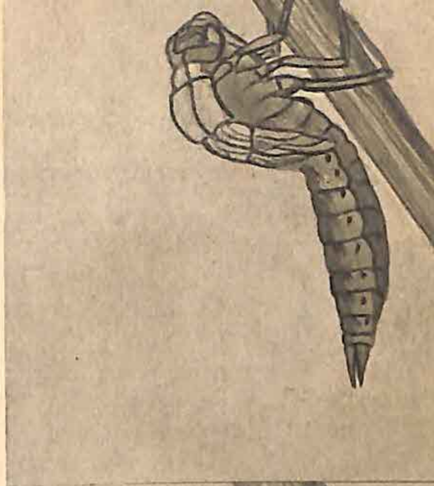


way of catching its food. Below its mouth is a structure like an arm with a pair of pincers at the end. Suddenly this "arm" is shot out, the pincers catch hold of a tadpole, then the elbow of the "arm" bends and the tadpole is pulled back to the mouth, to be chewed up by the jaws. You can see this happening in the picture at the top of the page. When not in use, the "arm" is folded under the head and hides the mouth. Its proper name is a MASK. No other animal has a mask like this.

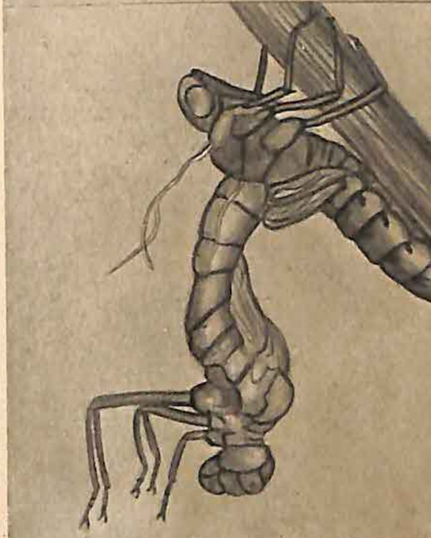
Notice also the three pairs of legs and the five short spines at the end of the body. If the larva is suddenly disturbed, it can move very quickly by sucking water into the hind end of the body, and then suddenly squirting it out again. The body shoots forwards by a kind of jet propulsion! Another strange thing about these nymphs is that they breathe at the hind end of the body. The water they suck in contains oxygen dissolved in it and this passes over a number of breathing-tubes (tracheal tubes). The oxygen passes through the thin walls of these tubes, and carbon-dioxide (CO_2) gas passes into the water and is washed away.

When the nymph is fully grown and ready to change into a dragonfly, it stops feeding for a few days. If you are keeping one in an aquarium, you should put a 3-foot stick with a rough surface into the aquarium to enable the nymph to climb out of the water. Watch carefully so that you do not miss one of the most exciting times in aquarium-keeping—the time when the nymph moults for the last time and becomes the dragonfly.

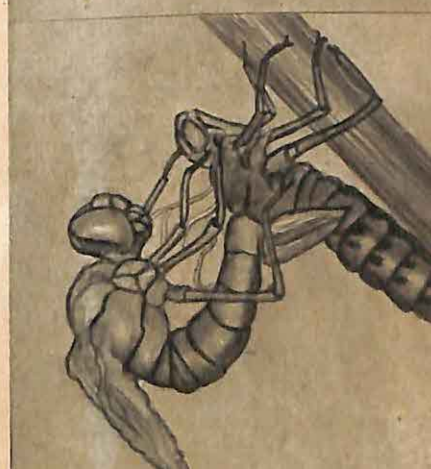
The nymph climbs slowly up the stem of a water plant, or up the stick in the aquarium. It holds on tightly with its legs, and as you watch you see movements under the skin as the dragonfly inside struggles to get out. Suddenly the skin splits behind the head. The slit gets longer and longer, and very slowly through this appears a green head with its two enormous shining eyes.



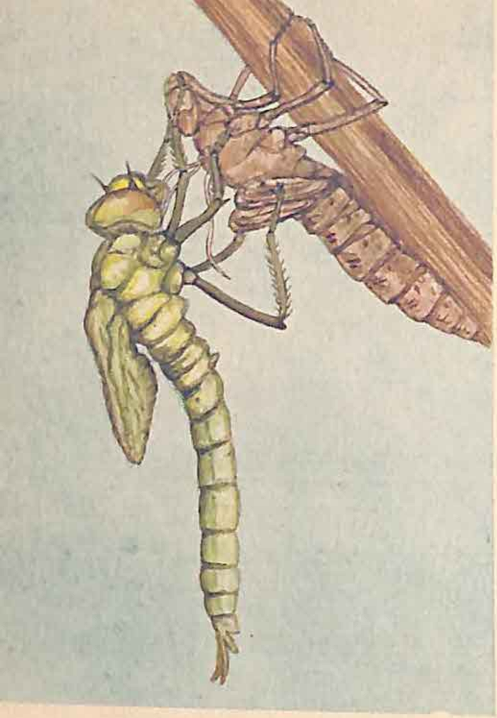
Gradually the body leans backwards. Each leg is pulled out separately. The wings at first look like small crumpled bags of skin. For about half an hour the insect hangs head downwards, resting after its struggle to get free.



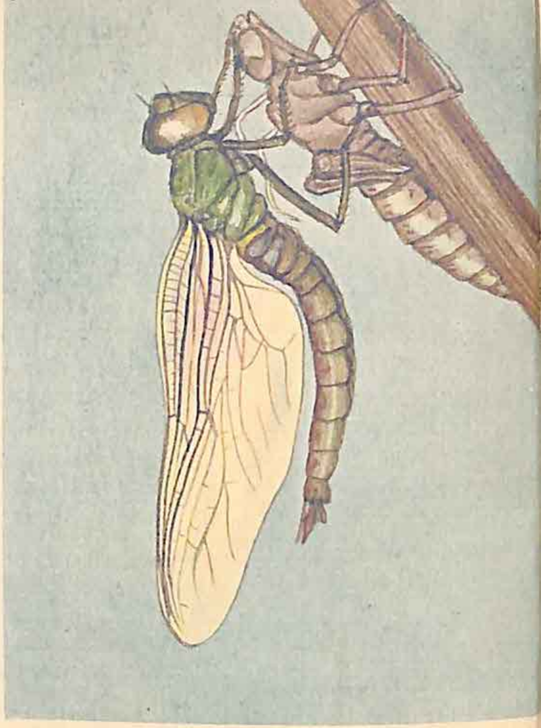
Suddenly the body swings upwards, and the legs grip the old empty skin, and the hind end of the body is pulled out of it. The dragonfly is now free.



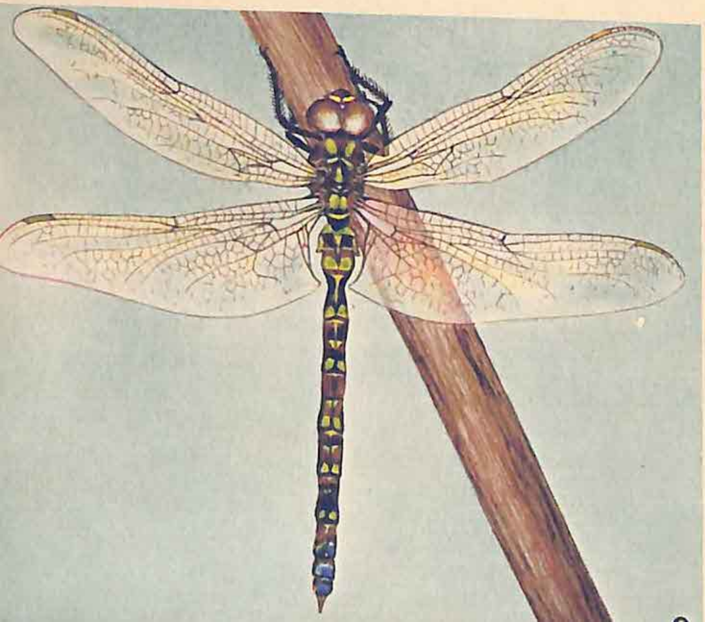
SENIOR BASIC TRAINING COLLEGE



The wings slowly begin to lengthen and the crumples disappear.



They become transparent and shining and reach beyond the tip of the body.



The insect now rests for several hours while its wings harden in the air. Often the nymph will leave the water between eleven o'clock at night and two o'clock in the morning, and after three or four hours' rest will fly off into the sunshine.

MAYFLIES

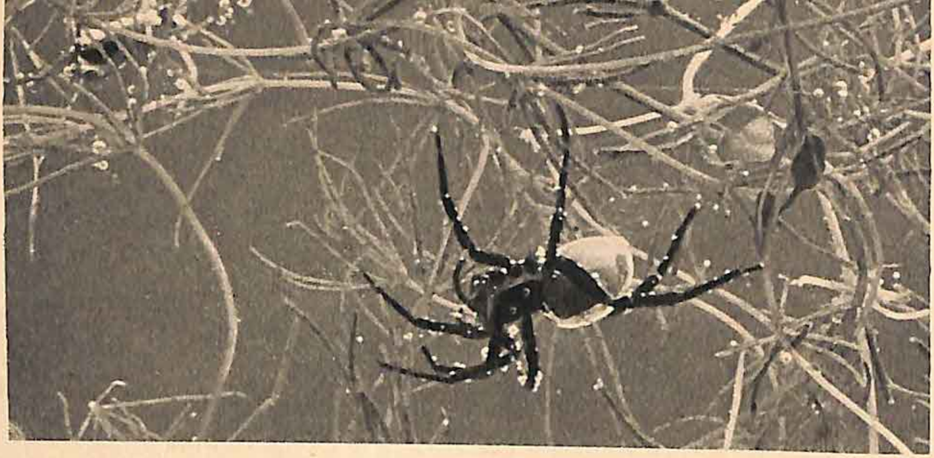
On warm summer evenings you may see hundreds of mayflies dancing together over the surface of the water which they have just left. They have spent two or three years in the pond as larvæ, feeding and growing in size until their wings formed and they became nymphs like the dragonfly. When full grown, they climbed up a water-plant stem, split their skin for the last time, and crawled out to join in the summer dance. The mayfly lives only for a few hours now, for it has no mouth and cannot feed. But before she dies the female lays her eggs in the water. Mayfly larvæ are brown in colour and burrow in the mud. They have a number of leaf-shaped gills at each side of the body and a three-pronged tail. They dart through the water with a quick jerky movement.

Thinking again of the lives of these insects, the water-beetles, the dragonflies, the caddis-flies, and the mayflies, you can see now how easy it is to recognise an insect. There are five things to look for:

1. There are three parts to the body, a head, a thorax, and an abdomen.
2. There are six legs.
3. They have special breathing-tubes, and when living in water they either use air for breathing or have gills and use the oxygen in the water.
4. Some have lives divided into three parts: an egg stage, a larva, and an adult.

   Others have four parts in their life: an egg stage, a larva, a pupa, and an adult. Can you name two insects for each kind of life?
5. Insects grow by changing their skin or moulting.

There are many other insect larvæ that live in ponds, but we cannot mention them all. The picture in the centre of the book will help you to name some of them. Look for the ghost larvæ, and the crimson bloodworms which are larvæ of midges and not worms at all. You will often find them at the bottom of the dish in which you put your pond dipping, but you will miss them unless you look carefully, for they quickly make themselves a little tube of mud in which to hide.



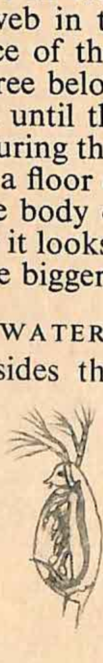
WATER-SPIDERS

Some people think that spiders are insects, but you can tell at once that they are not, because they have eight legs and not six. If you peer down into the still, clear water among the pondweeds, you may see the beautiful nest of the water-spider. It looks like a silver bubble fastened to the weed with threads of silk. There is a picture of one at the front of this book. The spider spins a sheet-like web in the water between two plants. She then goes to the surface of the water and brings down a bubble of air which she sets free below the web. Gradually more and more air is brought down until the web becomes dome-shaped. In this nest she rests, but during the summer she lays her eggs in the upper part and then spins a floor of silk to close in the nursery.

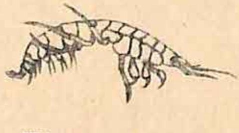
The body of the spider is covered with velvety hair, and under water it looks silver, as you can see in the photograph. The male is a little bigger than the female and makes a nest of his own.

THE WATER-SHRIMP, WATER-LOUSE, AND WATER-FLEA

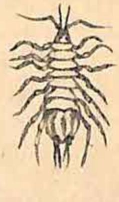
Besides the water insects and spiders, there are some other



Water-flea
(much enlarged)



Water-shrimp
(slightly enlarged)



Water-louse
(enlarged)

animals with many pairs of legs. There is the water-louse, a relation of the wood-louse that lives in gardens. It is an excellent scavenger and lives well in an aquarium. There are the water-shrimps that swim on their sides, and the tiny water-fleas which are so small that you need a lens to see them properly. These three creatures belong to a big group of animals called CRUSTACEA.

Then there are the leeches, with a sucker at each end of the body, that swim beautifully through the water, or crawl over the stems of plants like a looper caterpillar, and the flat-worms that glide smoothly across flat surfaces. They are black or white or grey.

NEWTS, TOADS, AND FROGS

Newts, toads, and frogs are some of the most interesting pond dwellers, for all spend the early part of their lives in water as tadpoles. Frog-spawn is well known to most people. Each egg is surrounded with jelly and the eggs stick together in masses. Toad eggs are also surrounded with jelly, but are arranged in long ropes that are twisted in and out of the water plants. Newt eggs each have a covering of jelly, but the female places them singly on water plants, sticking a leaf over each as she lays it. Once they have laid their eggs, frogs and toads leave the pond and come on land to feed during the summer. Newts, however, stay longer in the water, and can usually be found there any time during April until the beginning of July.

NEWTS are beautiful creatures during the breeding season. There are three different kinds, and all can be kept in aquaria. They have long, slender bodies, with a tail that is flattened from side to side. In the breeding season the males have a flap of skin down the back which is called a CREST, and which stands upright in the water. They have two pairs of legs and, though rather clumsy on land, are excellent swimmers. The hands have four fingers only, but the feet have five toes. Newts should be handled very carefully, for they have no ribs to protect them as we have.

The largest is the GREAT CRESTED NEWT or TRITON. It measures about 6 inches from nose-tip to tail-tip. The back and sides are brownish black, rough, with white dots at the sides. The crest of the male is jagged at the edge like a saw. There is a gap in this crest where the body ends and the tail begins. The underside is a brilliant orange-yellow. The females have no crest and are duller in colour.

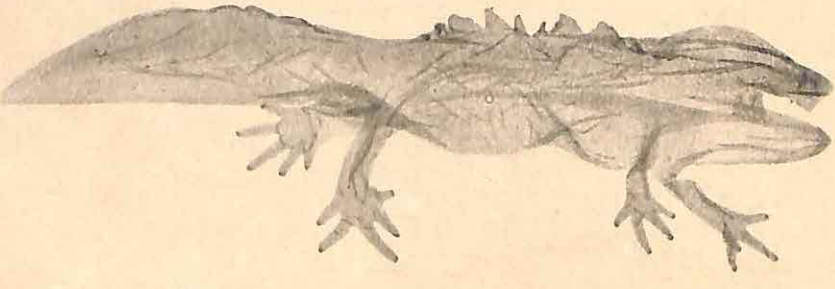
The SMOOTH OR COMMON NEWT is about 4 inches long, and is greenish brown, with dark lines on the head. The underside is orange with black spots. The crest of the male goes straight down the body and tail, and is wavy, not jagged. He has a bluish-white line down the lower edge of the tail. The female is duller in colour.

The PALMATED NEWT is rarer than either of the other newts. It is only about 3 inches long, and can be recognised by a little thread that sticks out from the end of the tail. In the breeding season the feet of the male are webbed and black.

Newts go to ponds about April or early May to lay their eggs, for they spend the winter on land hibernating.

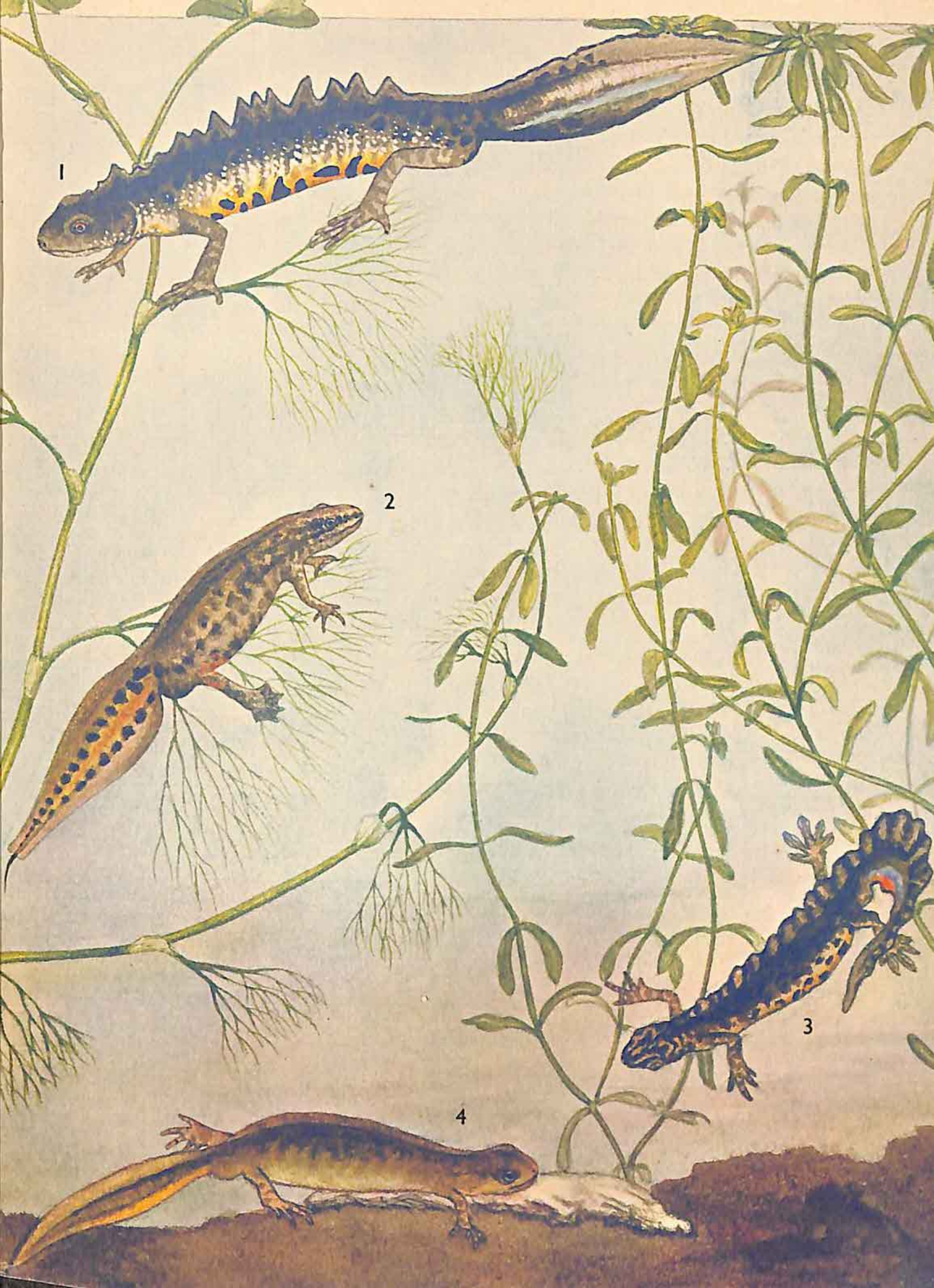
One can keep a pair of smooth newts in an aquarium. You can see the female lay her eggs, and then watch these eggs grow into tadpoles. Have one pair only in your aquarium, and prepare a 2-lb. jam-jar with weed and water to use as a nursery tank for the eggs and young tadpoles. Make a record of the things you notice. A record like that on page 30 is a useful one to keep. Each day count the number of eggs laid and enter this on the chart. Move the weed with the eggs into the nursery tank, and watch the tadpoles develop.

If you can get tiny water creatures from the pond, the newts will feed on these. They will feed also on tiny strips of raw meat, which should be held in front of them and moved about. Newts should be fed each day, and the number of pieces of meat eaten entered on the chart. Occasionally they shed their skins, and these can be found floating in the water. This skin can be mounted on paper. Slip a piece of paper under the skin, lift it gently, and drain off the water; then leave to dry. The picture below shows the empty skin of a crested newt.



1. Crested newt ♂
2. Palmated newt ♂

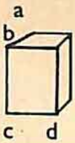
3. Smooth newt ♂
4. Smooth newt ♀


1
2
3
4

"Special events" on the chart would include such records as the dates when the skin was shed and the date when the first tadpole hatched.

Another record to make is one that shows in drawings how an egg grows into a tadpole, and how the tadpole becomes a newt. The drawings on the next page show some of the things to look for. Remember when making drawings always to put the date. The small drawings at the side show the real size. The big drawings show what can be seen under a microscope or with a lens.

The drawings were made from eggs laid in an aquarium on May 4th. They show only four parts of an exciting story. Can you fill in other details by watching eggs develop? Make drawings to show what you have seen.

Tap or Pond water used?	OUR NEWT AQUARIUM	The Tank  ab = 3″ bc = 9½″ cd = 7″

Curators	
Plants	
Animals	
Food given	

Date	Special events

Food taken					
Date	♂	♀	Date	♂	♀

Eggs removed from tank			
Date	Number	Date	Number

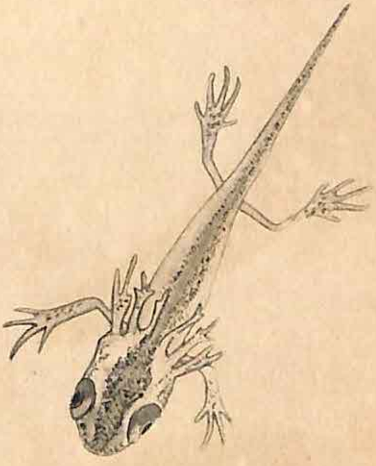
Total number of eggs laid	

At first the egg is a tiny ball inside another ball of jelly. It is tucked under a leaf of Canadian pondweed.

May 15*th*.—The egg is shaped like a tadpole and tiny gills can be seen.

May 25*th*.—The egg is almost ready to hatch, and the tadpole is seen moving inside the jelly. There are three pairs of gills, and farther back are two legs.

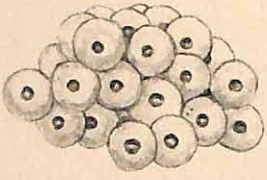
May 28*th*.—The tadpoles have hatched. They are very different from frog and toad tadpoles. They are almost transparent and have now two pairs of legs.



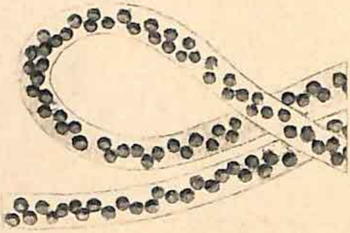
After the newt has laid a great many eggs, she keeps coming to the surface of the water and sits on the weeds. It is now time for her to come on land to feed during the summer months. Both male and female should now be set free at the edge of a pond. If they are kept in the aquarium, they will die.

Frogs, toads, and newts are known as AMPHIBIA, because they spend part of their lives on land and part in water. All young amphibians are tadpoles and are true water dwellers, breathing by gills. The adults are lung breathers, and live on land during the summer when they feed, and during the winter when they hibernate. They never go very far away from water, as they must lay their eggs there. Tadpoles never know their parents and have to look after themselves. You will find them crowding together in hundreds in the warm water at the edge of the pond. Remember that the black ones are toad tadpoles, and the brown ones with markings in yellow and gold are frogs.

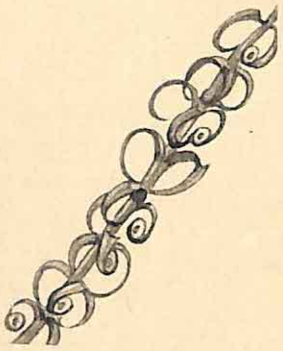
Watch eggs of frog and toad develop and compare them with those of the newt. There are a number of differences. Can you discover them?



Frog



Toad



Newt

When frog and toad tadpoles have got two pairs of legs, they should be kept in a home like the one used by the *Dytiscus* larva until they come on land. Once they have left the water they should be set free in a damp place near a pond.

SMALL FISH

Several kinds of small fish live in ponds. Some of the most interesting are the COMMON STICKLEBACKS (or "tiddlers" as they are often called), especially during April and May when they are building their nests. The name stickleback refers to the spines, or "stickles," which stand up on the back in front of the fin. These stickles can be raised, or lowered, and are used in fighting.

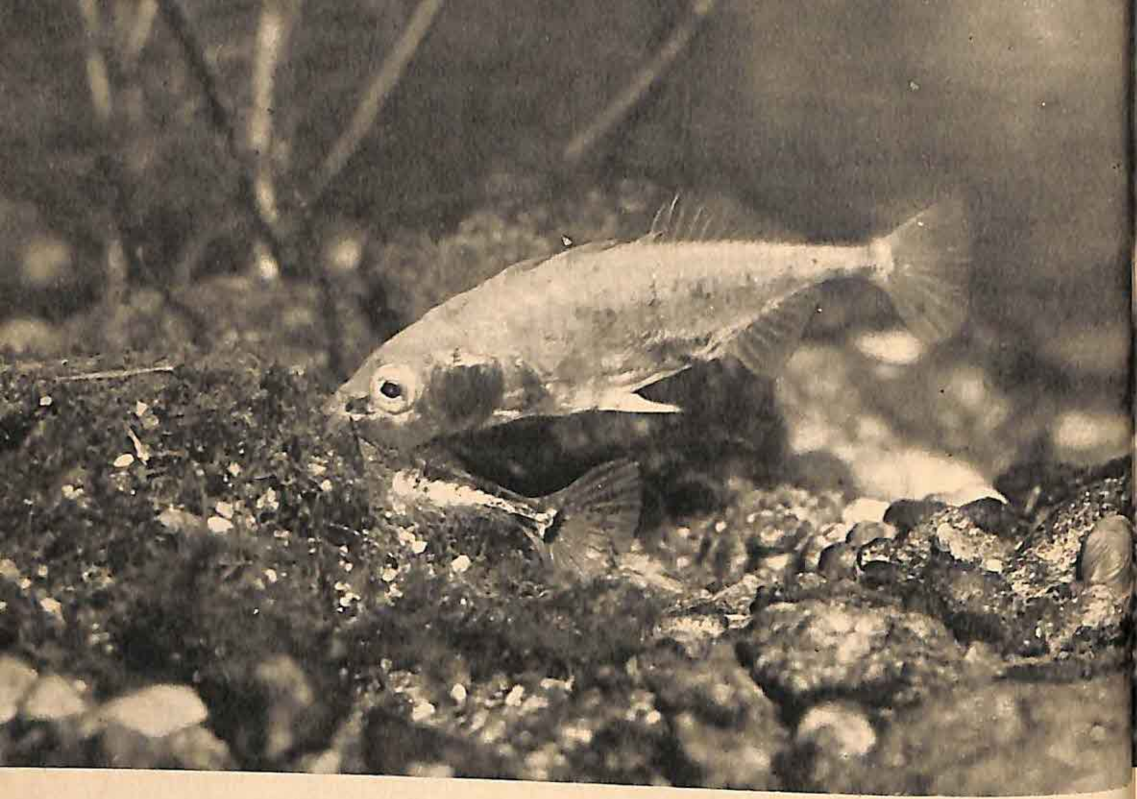
Common sticklebacks have three spines on the back, but they have two near relations, one with ten spines, and one that lives in the salt water of estuaries with fifteen spines.

Sometimes when you are looking into the weeds of a pond you may see a small brilliantly coloured fish, about 2 to 3 inches in length, darting backwards and forwards with tiny pieces of pondweed in its mouth. It is probably a father stickleback building his nest. You may think it strange that the father builds the nest, but, stranger still, it is he who looks after the young when they hatch from the eggs.

Watch carefully, and you may see him make a groove in the mud by pressing his body along the surface. Then he piles the bits of stem and leaves above it. Hour after hour he works, swimming backwards and forwards, and fastening the pieces together with a sticky substance from his body. As the pile gets higher, he pokes the pieces on the outside into position with his upturned nose. Then he pushes his body through the middle of the pile to make a small, barrel-shaped tube.

During the time of nest-building, the colours of his body brighten and glow, until his sides and throat are a brilliant crimson, his back a lovely sea-green, and his eyes a vivid blue. If any fish should approach the nest, he attacks it fiercely with his stickles raised. If, however, a female stickleback approaches, he swims towards her, and leads her to the nest. In the photograph on the next page you can see her in the nest. She is probably laying eggs. She then swims away and the male at once enters the nest and fertilises the eggs. If the female returns, he immediately drives her away. Female sticklebacks are not brightly coloured, but are a pretty silver grey.

From now on the male guards the nest. He hovers over it, fanning with his fins to keep a current of water moving over it. In two to three weeks' time, minute transparent fish hatch from the

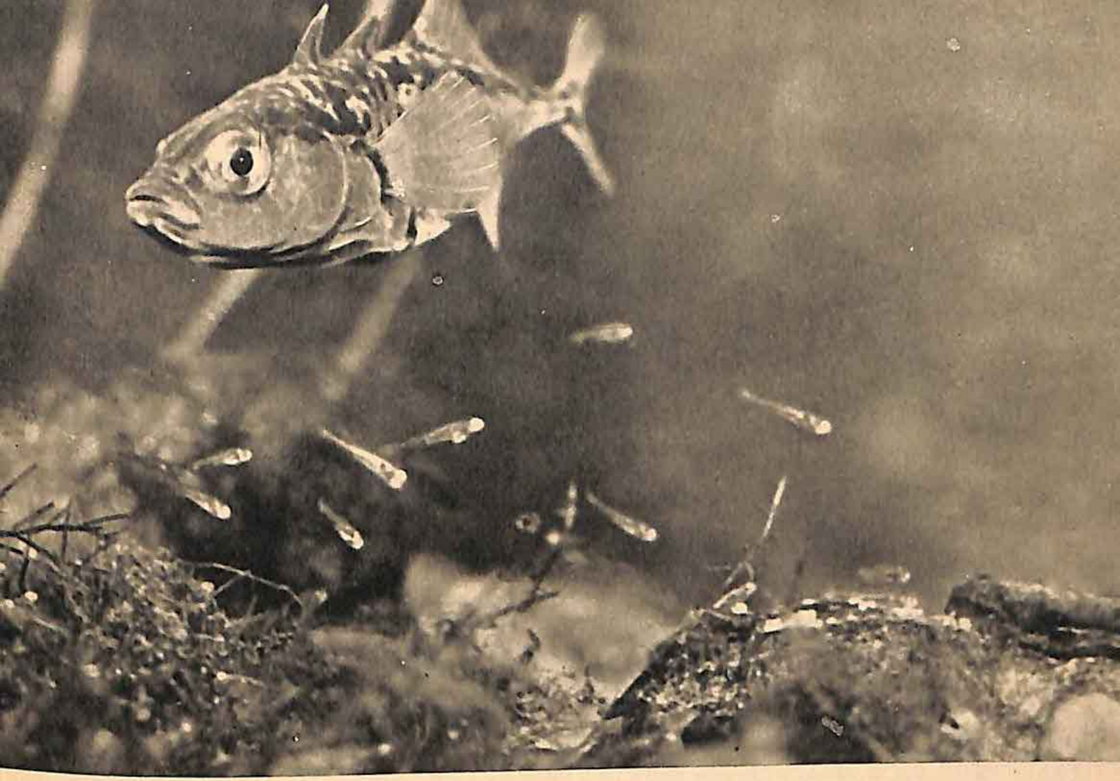


The female stickleback enters the nest

eggs. So tiny are they, that at first it is only just possible to see them. They are called FRY. If they try to swim away, the father drives them back into the nest. Indeed, if they are too adventurous, he sucks them into his mouth, then squirts them back again into the nest!

The photograph on page 35 shows the male swimming with his family.

They feed on tiny insects and worms in pond water. The adults have tremendous appetites, and this should be remembered when



Male stickleback with young

they are kept in aquaria. Once the female has laid eggs, she should be moved to another aquarium, or the male may attack and kill her.

The more you go pond-dipping, the more animals and plants you will discover. This book tells you about only a few that you can see without a microscope. Remember that pond water is full of thousands of plants and animals, which, without a microscope, you cannot see at all.

The chart on the next two pages will help you to name those you find.

SOME FRESH-WATER

A. NO LEGS VISIBLE.

B.

(1) HYDRA.

Minute tube-like creatures with 6 or 8 tentacles.

(2) FLAT-WORMS.

Flat animals never bigger than 1 inch. They glide over stones and plants.

(3) LEECHES.

Worm-like with flattened bodies, moving with a looping action. They have 2 suckers, one at each end of the body.

(4) BLOODWORMS.

Bright red, about 1 inch long, swim by waving the body. Make tubes of mud. Larva of a midge.

(5) GHOST LARVA.

Transparent, about ½ inch long, remains motionless in a horizontal position. When disturbed, it flicks its tail and moves jerkily through the water.

3 pairs of legs
(INSECTA).

(a) *Under water.*

Caddis larvæ (live in tubes).
Dragonfly larvæ.
Mayfly larvæ (3 tail prongs).
Water-beetles.
Beetle larvæ (2 tail prongs).
Alderfly larvæ (1 tail prong).
Water-scorpion.

(b) *On the surface.*

Pond skater.
Water-gnat.

SOME FRESH-WATER

FISHES.

ANIMALS WITHOUT BACKBONES

JOINTED LEGS.

4 pairs of legs
(ARACHNIDA).
Water-spider.
Water-mite.

Many pairs of legs
(CRUSTACEA)
Water-shrimp.
Water-louse.
Water-fleas.

C. EXTERNAL SHELL.

(1) UNIVALVES.
Pond snails.
Fresh-water limpet.

(2) BIVALVES.
Pond mussels.
Pond cockles.

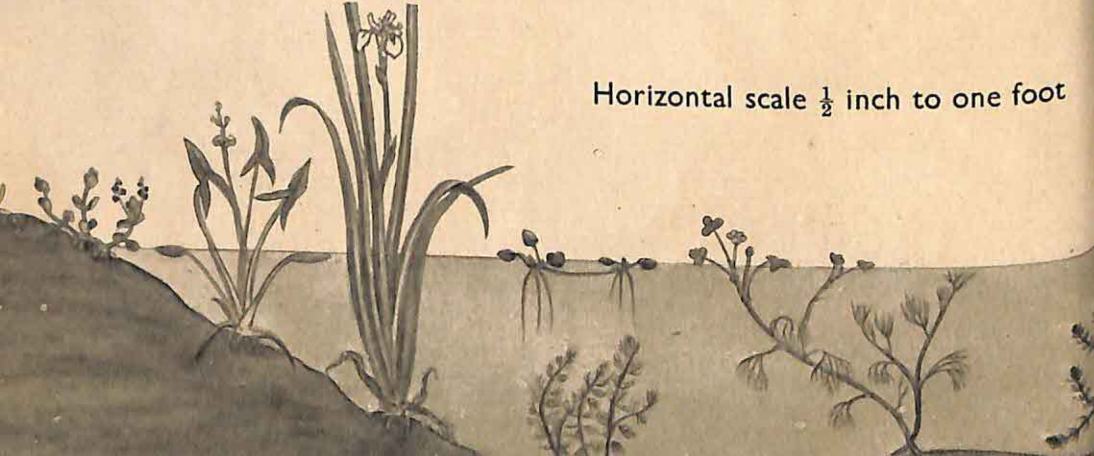
ANIMALS WITH BACKBONES

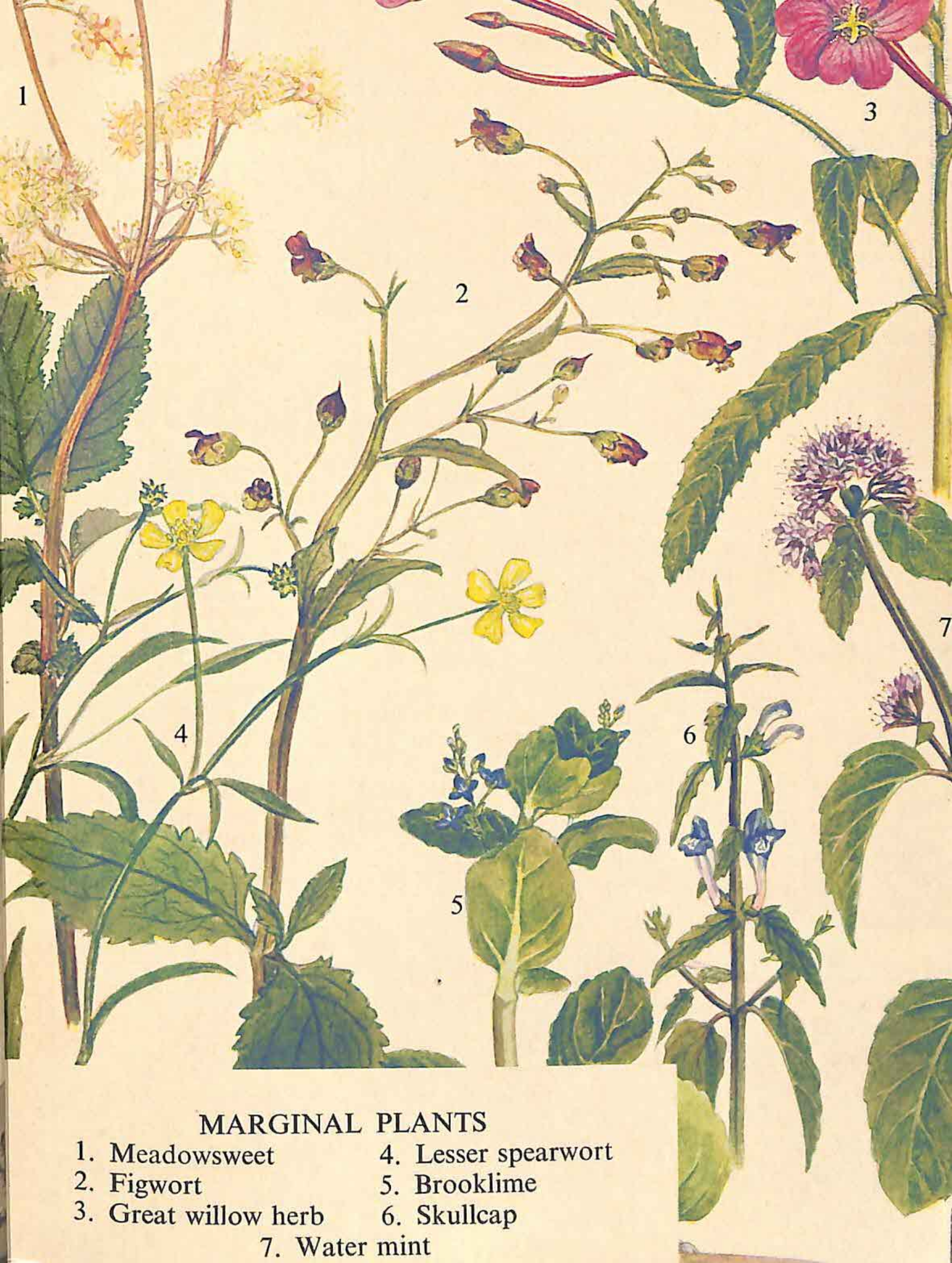
AMPHIBIA.
Frogs.
Toads.
Newts.

THINGS TO DO

At the beginning of this book it was suggested that you should keep a diary throughout the year, recording your discoveries about some pond. Here are more suggestions for records you could make.

(1) Make a plan of the pond.
(2) Try to discover why it exists in this place.
(3) Mark in the trees nearby.
(4) Mark in the flowering plants you find:
    (*a*) growing on the bank,
    (*b*) growing at the edge in the water (called marginal plants),
    (*c*) the true water dwellers, (the book *Aquaria* in this series will help you to name them).
(5) Keep a record of the dates of flowering, and of fruit formation. Notice how the fruits and seeds are scattered.
(6) Collect pictures, and make drawings of the flowers you find. The picture opposite shows six common marginal plants.
(7) The picture at the bottom of the page shows one way of making a record of the plants growing in a pond. It is called a TRANSECT. Mark off one-foot lengths along a piece of rope with knots of string, then stretch this rope across the pond, fixing it at both ends with a stick. In your drawing show what kind of plant is growing along the line at each foot mark. The depth of the water can be found by using a stick, also marked in one-foot lengths.
(8) Find the temperature of the water (*a*) at the surface, and (*b*) at the bottom, during each month of the year.


Horizontal scale ½ inch to one foot



MARGINAL PLANTS

1. Meadowsweet
2. Figwort
3. Great willow herb
4. Lesser spearwort
5. Brooklime
6. Skullcap
7. Water mint

INDEX

Numbers printed in heavy type show where there are pictures.

Bloodworm, **20, 21,** 25, 36

Caddis, 4, 16, **17,** 18, 25, 36

Dragonfly, 3, 5, 18, 19, **20, 21, 22, 23, 24,** 25, 36

Fish, 3, 5, 11, 33, **34, 35,** 36
Flat-worm, 5, **20, 21,** 27, 36
Fresh-water molluscs, **12**
Fresh-water winkle, **12, 20, 21**
Frog, 27, **32,** 37

Ghost larva, **20, 21,** 25, 36

Leech, 5, **20, 21,** 27, 36

Mayfly, 5, **20, 21,** 25, 36

Newt, 5, **20, 21,** 27, **28, 29,** 30, **31, 32,** 37

Pond cockle, **10,** 11, **20, 21,** 37
Pond mussel, **10,** 11, **20, 21,** 37
Pond snail, 5, **6,** 7, **8, 9, 20, 21,** 37
Pond water, 3, 4

Shell collections, **11**
Stickleback, 33, **34, 35**

Things to do, 38
Toad, **20, 21,** 27, **32,** 37
Transect, **38**

Water-beetle, 3, 5, 13, **14,** 15, **20, 21,** 25, 36
Water-boatman, 5, 16, **20, 21**
Water-bug, 16
Water-flea, **26,** 27, 37
Water-gnat, 4, 36
Water-louse, 4, **20, 21, 26,** 37
Water-scorpion, 5, 16, **20, 21,** 36
Water-shrimp, **26,** 27, 37
Water-skater, 4, 16, **20, 21,** 36
Water-spider, **2,** 5, **20, 21,** 26, 37

OTHER BOOKS IN THIS SERIES

1. AQUARIA

Gives instructions for the setting-up and maintenance of a fresh-water aquarium.

3. WASPS

Describes in detail the study of wasps and a wasps' nest

FULLY ILLUSTRATED

Printed in photogravure by the
Grout Engraving Company, Limited, Bromley, Kent.